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ACADEMIC MEDICINE

JOURNAL OF THE ASSOCIATION OF AMERICAN MEDICAL COLLEGES

HMOs and Medical Education

Computers in Clinical Education

Theme: AIDS and Attitudes

- Medical, Dental, and Nursing Students
- Impact of AIDS Information
- Willingness to Treat AIDS Patients
- Faculty and Students

In-Training Examinations

Effect of Minority Enrichment Program

AAMC Data Report: Debt and Specialties

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A Survey of Medical School Teachers to Identify Basic Biomedical Concepts Medical Students Should Understand

BETH DAWSON-SAUNDERS, Ph.D., PAUL J. FELTOVICH, Ph.D., RICHARD L. COULSON, Ph.D., and DAVID E. STEWARD, M.D.

Abstract—Insights from the cognitive sciences indicate a continuing need for physicians to understand conceptual knowledge from the basic sciences, despite recent concerns regarding the increasing amount of information in medicine and the growing emphasis on performance skills. A 1987 survey of selected basic science and clinical teachers in North American medical schools was undertaken to identify basic biomedical concepts that are important in the practice of medicine and to specify how difficult these are for students to learn, apply, or both. Responses from faculty (nominated by their deans to answer the survey) from 82% of the medical schools indicated considerable agreement between the basic science teachers and clinical teachers on the relative importances of a set of biomedical concepts, and showed relatively minor levels of disagreement on how difficult these concepts are. The judgments of these teachers could prove extremely useful in (1) determining concepts that—because of their importance—should receive special attention in curriculum efforts, and (2) determining concepts that—because of their difficulty—need "special handling." *Acad. Med.* 65(1990):448-454.

At least two recent trends have converged to create what can be seen as a confusing picture within medical education regarding the role of conceptual knowledge from the basic sciences in the education of the physician. The first trend is what is commonly referred to as the "information explosion," the proliferation of new and changing knowledge in fields pertinent to medical practice. One response to the proliferation of medical information has involved proposals for better technologies for providing access to information.[1] Another response addresses the curriculum for medical education; if the knowledge base is constantly changing and expanding, then it is not feasible to try to teach it all. This response has led, for instance, to an emphasis on teaching the skills of knowledge acquisition or self-directed learning and to calls for greater focus within the curriculum.[2,3] The second trend involves uncertainty about the relationship between conceptual knowledge of subject matter and the professional tasks and performances of the physician.[4] Perhaps influenced also in part by a dissatisfaction with standard methods of testing for knowledge, this trend has engendered an increased emphasis on performance, both in the training for professional skills and in the assessment of professional competence.[2,3,5]

Both of these trends could lead medical education toward a de-emphasis of basic conceptual knowledge from pertinent subject areas (such as the basic biomedical sciences), in favor of skills of performance and knowledge acquisition. However, some recent developments in the cognitive sciences should give pause to any movement of this sort. The first is the indication that conceptual knowledge and skills of performance and learning are highly intertwined and build off each other, so that neither can be slighted in the acquisition of competence.[6,7] The second is evidence that suggests that expert problem solvers are sometimes guided in their performances by basic concepts and principles within the subject matter of their fields.[8,9] The third involves mounting evidence that some difficult scientific concepts are rarely understood well by students and that misconceptions, once acquired, are difficult to correct.[10,11]

These three cautions have been reinforced in the reappraisal of the GPEP report (that is, the report of the Panel on the Geneval Professional Education of the Physician and College Preparation for Medicine) conducted by the Council of Deans and the Council of Academic Societies working groups of the Association of American Medical Colleges.[12] Their recommendations can be inter-

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preted as acknowledging that medical information and medical concepts are not necessarily the same, and that some basic medical concepts are important and must be understood well. In addition, it should be recognized that an emphasis on fostering clinical performance skills and learning skills can be compatible with an emphasis on understanding biomedical concepts.[13] But the information explosion still exists, and even the realm of biomedical science concepts is large. If the curriculum is to prune some teaching of information in favor of fostering deep understanding of concepts — and assuming there must be some focus even within concepts — how is this focus to be guided?

The present paper reports results of a 1987 survey of medical school teachers (both basic science and clinical) that was designed to identify basic biomedical science concepts that these teachers considered to be both important for achieving competence in the practice of medicine and difficult for students to learn, understand, and apply. (The survey was one component of a larger research project investigating biomedical understanding and the role of biomedical science knowledge in the clinical reasoning and performance of the physician.) In this article, the development and nature of the survey are presented first, followed by the results and their implications for medical school curricula and research.

Method

The design of the survey and analysis of the results required several steps: defining the content of the questionnaire, designing its format, the two-stage sampling plan, and the analysis.

Choosing Survey Concepts

A set of biomedical concepts that could be included in the survey was identified through interviews conducted with the teaching faculty at Southern Illinois University School of Medicine, Carbondale and Springfield, and with basic science researchers and teachers at a national physiology meeting. The disciplines represented included five basic sciences and five different areas of internal medicine. The persons interviewed were asked to nominate and discuss those basic science concepts "important to the practice of medicine" that their teaching had shown were difficult for students to understand and apply. They were also asked to identify important concepts that, although complex, they judged to be less difficult. Content descriptions were obtained for 160 concepts. A basic science expert (R.C., a physiologist) and a clinical expert (D.S., a general internist) independently selected from this list concepts each considered to have the greatest ramifications for facilitating the learning of other concepts in the basic sciences or for promoting a good understanding of underlying processes important in clinical medicine. Their lists contained 17 concepts in common; the concepts on the two lists showed significant agreement beyond chance ($p < .05$, McNemar test). These 17 concepts, considered important by both a basic scientist and a clinical expert, were included on the questionnaire. Ten additional concepts were chosen, five from the clinician's list and five important but less difficult ones from the original list of 160. The latter were included to provide a balance of concept difficulty within the questionnaire. The 27 concepts were included on the questionnaire in randomized order.

Designing the Questionnaire

The questionnaire consisted of four major sections plus questions about the respondent's discipline and teaching background. The first section contained the 27 biomedical concepts and four questions about each: (1) was the faculty member involved in a substantial way in teaching the concept; (2) a rating of how difficult the concept is for medical students to learn and understand during basic science years (on a scale from 5 = very difficult to 1 = not very difficult); (3) a rating of how difficult the concept is for students to recognize and/or apply in clinical situations (identical five-point scale); and (4) how important the concept is to the practice of medicine (scale from 5 = very important to 1 = not very important). The option "Cannot estimate" was included for the three rating questions.

The second and third sections of the questionnaire asked faculty to choose concepts that should be the subject of research on students' learning and understanding of medical concepts. In section two, these were chosen from the 27 concepts provided; section three provided an opportunity for faculty to nominate additional concepts. The fourth section asked for more detailed discussion of any two concepts selected by the faculty member. The questionnaire was pilot-tested, which led to development of an eight-page questionnaire format that was estimated to require approximately 30 minutes to complete.

Sampling

A two-stage sampling procedure was used to identify appropriate faculty respondents. In the first stage, the deans of all U.S. and Canadian medical schools were sent a letter in 1987 explaining the purpose of the project and asking them to nominate six faculty at their institutions with interest and experience in the education of medical students. (The authors' medical school was not included because several of the faculty had participated in research activities, including generating the concepts.) The entire range of basic and clinical science disciplines was systematically sampled across schools such that, within each school, the dean was asked to provide names for three basic and three clinical science disciplines. In the second stage, the faculty members suggested by the deans were sent a cover letter and the questionnaire. Follow-up efforts consisted of a postcard reminder approximately one month after receipt of the first mailing and a second complete mailing approximately two months later. Recipients of the second questionnaire were asked to return the cover letter sent with the questionnaire if they did not plan to respond.

Analysis

Basic descriptive statistics included proportions, means, and medians. Statistical analyses were performed using analysis of variance followed by Tukey comparisons (HSD), chi-square and Wilcoxon rank sum tests, and nonparametric correlations; only those results statistically significant at $p < .05$ are reported.

The 247 new concepts nominated by respondents in part three of the questionnaire were categorized by one of the authors (RC). All of these concepts were reanalyzed three months later by the same author without reference to the original analysis, in order to establish the consistency of the categorization. The same major categories established in the first analysis were independently established during the second analysis. Furthermore, there was an 80% agreement between these two separate categorizations of the new concepts nominated by the survey respondents.

Results

One-hundred-fifteen of the deans responded (representing 82% of the surveyed medical schools), and provided names of 324 faculty members from seven different basic science disciplines and 318 faculty from seven different clinical specialties, a total of 642. Of these, 427 (67%) responded. In this group, 44 stated they were not qualified to complete the questionnaire, and 37 opted not to fill out and return the second mailing; the remaining 346 questionnaires (54% of the original sample) were analyzed. Responses from one or more faculty were received from each medical school whose dean had nominated faculty to respond to the survey. The response rates from faculty in the basic science disciplines ranged from 23% in the behavioral sciences to 73% in physiology; in clinical specialties, the range was from 44% in psychiatry to 74% in internal medicine. The overall response rates did not differ significantly between the basic science faculty (56%) and the clinical faculty (52%).

The mean numbers of years the respondents had taught in a medical school were 17.7 years for the basic science faculty (SD = 8.0 years) and 12.9 years for the clinical faculty (SD = 8.0 years). In addition to extensive educational experience, 88% of these faculty reported that at the time of the survey or in the past they had had some level of administrative responsibility for curriculum.

Table 1 lists the 27 concepts included on the questionnaire, ranked by the relative magnitudes of the mean ratings of importance they were perceived to have "to the practice of medicine." Also given are the rankings of the mean ratings assigned to each concept with respect to both difficulty in the basic science years and difficulty of clinical application. Finally, the table presents the rankings (by the number of times nominated) of the concepts recommended as important as subjects of further research about students' learning. The mean ratings upon which the first two sets of rankings (importance and difficulty) were based are also presented. All 27 concepts were considered to be important in the practice of medicine, based upon the rating scale; the mean ratings varied from 4.6 for acid–base, electrolyte balance to 2.7 for vascular steal phenomena (5 = very important, 1 = not very important). Standard errors on all rating scales were approximately 0.07; thus, 99% confidence intervals for the mean ratings are plus or minus approximately 0.18.

The respondents were categorized according to several dimensions for statistical comparisons: whether their disciplines were basic science or clinical; whether their graduate degrees were Ph.D. (or Sc.D.), M.D., or Ph.D./M.D.; and by their disciplines or specialties. Because of the redundancy in these comparisons and the general consistency in the responses, only the comparisons for basic science versus clinical science are reported in Table 1. There were few differences between the basic science and clinical faculty members' perceptions of the importance of the concepts. They agreed upon the importance of all concepts except three: mechanisms by which neurotransmitters and other hormones affect emotion, biochemical mechanisms of turning food into energy, and the complement system. In all three cases the basic science faculty rated these concepts as more important than did the clinical faculty.

The mean ratings of difficulty in learning the concepts in the basic sciences varied from the most difficult, renal concentrating mechanisms (3.9), to the least difficult, anatomy of the spinal cord in relationship to dermatomes and vascular steal phenomena (2.2) (5 = very difficult, 1 = not very difficult; Table 1). There were 20 concepts rated similarly by basic science and clinical faculty, and seven concepts for which the mean ratings of difficulty differed between them. The basic science faculty rated ventilation/perfusion relationships as more difficult to learn in the basic sciences than did the clinical faculty. The clinical faculty, on the other hand, rated mechanisms by which hypertrophies develop; factors contributing to opposition to blood flow; complement system; hormonal aspects of digestion, absorption, and gastrointestinal motility; clonal nature of the immune response; and biochemical mechanisms of turning food into energy all as more difficult to learn in the basic sciences than did basic science faculty.

The mean ratings of difficulty in recognizing and/or applying the concept in clinical situations ranged from 3.7 for the most difficult, acid–base, electrolyte balance, to 2.3 for the least difficult, vascular steal phenomena. Again, there was general agreement on the difficulty levels of concepts, with disagreement on only five. In each instance the clinical faculty rated the concept to be more difficult to apply in clinical situations than did the basic science faculty. The five concepts were spinal cord anatomy in relationship to dermatomes; relationship of reticular activating system and state of arousal to other higher neurologic functions; complement system; hormonal aspects of digestion, absorption, and gastrointestinal motility; and mechanisms of muscle activation and control of contraction.

When distinctions between basic

Table 1

Rankings and Mean Ratings of 27 Biomedical Concepts Rated by Selected Science and Clinical Faculty According to "Importance to Practice of Medicine," Difficulty for Students to Learn and/or Apply, and Importance as Subjects of Further Research; 115 North American Medical Schools, 1987*

	Ranking by Magnitude of Mean Rating						
	Importance		Basic Science Difficulty		Clinical Difficulty		Ranking by No. of Times Concept Recommended for Research‡
Concept	Ranking	Mean Score†	Ranking	Mean Score†	Ranking	Mean Score†	
Acid–base, electrolyte balance	1.0	4.6	2.0	3.8	1.0	3.7	1.0
Mechanisms of hypoxemia	2.0	4.5	25.0	2.4	26.0	2.4	6.0
Feedback systems in endocrinology	3.0	4.2	24.0	2.5	24.5	2.6	4.0
Central control of systemic blood pressure	5.0	4.1	18.5	2.9	18.5	2.9	7.0
Interlocking regulation/control of cardiac output and central venous pressures	5.0	4.1	11.5	3.3	11.0	3.3	9.0
Alpha and beta receptors: distribution, mechanisms of action and interaction in various tissues	5.0	4.1	11.5	3.3	11.0	3.3	3.0
Serum sodium osmolarity and controls	7.5	4.0	8.0	3.4	7.0	3.4	
Ventilation/perfusion relationships and mismatches	7.5	4.0	8.0	3.4§	7.0	3.4	
Glomerular filtration rate in relation to serum creatinine and creatinine clearance	9.0	3.9	21.0	2.7	21.5	2.7	
Statistical properties of diagnostic tests and their use in revising estimates of the presence of disease	10.5	3.8	13.5	3.2	13.0	3.2	2.0
Nutrient, electrolyte, and water exchange across the cell membrane	10.5	3.8	8.0	3.4	7.0	3.4	12.5
Factors contributing to opposition to blood flow; e.g., resistance, compliance, inertance	12.5	3.6	13.5	3.2‖	14.0	3.1	
Renal concentrating mechanisms and the counter-current exchange system	12.5	3.6	1.0	3.9	2.0	3.6	10.5
Hormonal aspects of digestion, absorption, and gastrointestinal motility	15.5	3.5	18.5	2.9‖	16.0	3.0‖	
Oxyhemoglobin dissociation curve and factors that affect it	15.5	3.5	16.5	3.0	16.0	3.0	
Control and coordination of body movement: mechanisms and dysfunctions	15.5	3.5	8.0	3.4	11.0	3.3	
Anatomy of the spinal cord in relationship to dermatomes	15.5	3.5	26.5	2.2	21.5	2.7‖	
Production and function of various types of prostaglandins	19.0	3.4	21.0	2.7	21.5	2.7	12.5
Lung surfactant and reduction of surface tension in alveoli	19.0	3.4	21.0	2.7	21.5	2.7	
Complement system: classic pathway, alternate pathway	19.0	3.4§	3.0	3.6‖	3.5	3.5‖	
Clonal nature of the immune response: one cell–one specificity	21.0	3.3	16.5	3.0‖	16.0	3.0	10.5
Mechanisms by which neurotransmitters and other hormones affect emotion	22.0	3.2§	4.5	3.5	7.0	3.4	5.0
Biochemical mechanisms of turning food into energy that is useful at the cellular level, e.g., Krebs cycle, lipolysis, maintenance of ATP	23.0	3.0§	8.0	3.4‖	7.0	3.4	8.0
Relationship of reticular activating system and state of arousal to other higher neurologic functions	24.5	2.9	4.5	3.5	3.5	3.5‖	
Mechanisms by which hypertrophies develop in different organs	24.5	2.9	23.0	2.6‖	24.5	2.6	
Mechanisms of muscle activation and control of contraction	26.0	2.8	15.0	3.1	18.5	2.9‖	
Vascular steal phenomena	27.0	2.7	26.5	2.2	27.0	2.3	

*The authors, through interviews with medical school teachers and researchers, identified 160 concepts "important to the practice of medicine" and agreed upon 27 important ones as the basis of a questionnaire sent to selected faculty at all North American medical schools. The faculty were asked to rate each concept according to its importance to the practice of medicine and its difficulty (in both basic science and clinical learning). They also were asked to choose concepts that should be the subject of future research on students' learning and understanding of those concepts. A total of 346 of the questionnaires were completed (54% of the original sample).

†Range of scores was from 1 = not very to 5 = very.

‡In this column, the rankings are according to the number of times each concept was proposed as a candidate for further research. All concepts nominated by 25 or more faculty are included.

§Concepts basic scientists rated higher.

‖Concepts clinical scientists rated higher.

science and clinical faculty were ignored, there was strong agreement that concepts difficult to learn in the basic sciences are also difficult to recognize and apply in clinical situations. Except for spinal cord anatomy, the differences between mean ratings on difficulty in clinical situations and in basic science were 0.3 points or less on the rating scale. This interpretation was strengthened by the finding that the rank order correlation between ratings of difficulty in basic science and difficulty in clinical application was .87.

Comparisons were also made between the faculty who indicated they were involved in teaching each concept and those who did not teach the concept. There was a tendency for those who taught the concept to rate it higher in importance than did those who were not teaching it; this difference was observed for 17 of the 27 concepts. However, there were few differences between teachers and nonteachers in their ratings of difficulty. On two concepts the teachers rated the concept more difficult, while on three others they rated it less difficult; there were no significant differences in the remaining 59 comparisons.

In order to summarize the respondents' ratings for the relative importances of the concepts and their difficulties for students to learn (in basic sciences and to apply in clinical situations), the median ratings were considered the dividing points between high and low on these rating scales. For importance, this point was 3.5; for difficulty, it was 3.0.

Based on this classification, nine concepts were judged to have the combined qualities of being rated high in importance to the practice of medicine, high in difficulty to learn in the basic sciences, and high in difficulty to apply in clinical situations. These concepts were acid–base, electrolyte balance; regulation of cardiac output; alpha and beta receptors; statistical properties of diagnostic tests; nutrient, electrolyte exchange; renal concentrating systems; serum sodium osmolarity and controls; factors related to opposition of blood flow; and ventilation/perfusion relationships. The first six concepts on this list were among the 13 concepts (also in the table) that were selected by 25 or more faculty for further research on how students learn and understand them. The other concepts recommended for further research included three that were rated high in importance but relatively low in difficulty (mechanisms of hypoxemia; feedback systems in endocrinology; and central control of systemic blood pressure); two that were rated relatively low in importance but high in difficulty to learn and apply (mechanisms by which neurotransmitters affect emotion, biochemical mechanisms of turning food into energy); and two that were judged relatively low in importance and low in difficulty (production and function of prostaglandins; the clonal nature of immune response).

The respondents nominated an additional 247 concepts (besides the 27 included on the questionnaire) that they thought were important to the practice of medicine and/or difficult to learn and apply. The footnote* contains a summary of the additional concepts, organized by the authors' classification scheme developed in the content analysis. (The list of all nominated concepts is available from the authors.) This classification scheme is not presented as unique or prescriptive, but is simply reported as a reasonable way of conveying the major content areas of the data, in full awareness that other basic scientists or clinicians could organize the concepts in other reasonable ways.

Eighty-nine of the nominated concepts were related to the basic sciences; of these, 48 were physiologic concepts covering a broad range of traditional topics (neurology, cardiovascular, renal, respiratory, gastrointestinal, endocrine, and others). Fourteen concepts were pharmacologic, ten were in biochemistry, a few were related to molecular or microbiological immunology, and seven were anatomic. Seventy-nine concepts were nominated on clinical science topics; 13 each were in the areas of (1) internal medicine, such as neurology—for example, mechanisms of pain—and cardiology—for example, osmotic fluid shifts; (2) clinical pharmacology, such as mechanisms of drug toxicity; (3) genetics oncology, such as genetic diagnostic probes, inborn errors of metabolism, oncogenes, and carcinogenesis; and (4) microbiology-immunology, such as vaccine design, virology, and bacteriology. Seventy-nine concepts in clinical and preventive medicine and associated topics were also nominated; of these, 23 were related to general clinical medicine and included therapies, such as antibiotic usage; procedural management, such as anticoagulant therapy and responses to IV nutrition; and addiction, such as alcohol and nicotine. Another seven were related to clinical skills, such as differential diagnosis and interviewing. Thirteen topics were in decision making, statistics, and experimental design, such as clinical decision making, incidence and prevalence, and scientific method in medicine; and another eight related to epidemiologic concepts, such as demographics, environmental exposure, and clinical epidemiology. Nineteen concepts pertaining to psychosocial issues—such as stress, compliance, and family systems—were nominated; and another nine dealt with

*The concepts are in the following categories; each category is followed by a number indicating how many times concepts within it were nominated: *Basic sciences* (89 nominations): physiology (consisting of neuromuscular, 8; gastrointestinal, 5; metabolism, 8; aging, 2; cardiovascular, 12; respiratory, 3; renal, 1; endocrinology, 5; and reproduction, 4); anatomy/embryology/neuroanatomy, 7; pharmacology, 14; biochemistry, 10; molecular biology, 7; and microbiology/immunology, 3. *Clinical sciences* (79 nominations): internal medicine/pathophysiology (consisting of psychological-neurology interactions, 6; and cardiology, 7); pathology, 11; pharmacology, 13; biochemistry, 3; family practice, 5; emergency medicine, 2; genetics oncology, 13; infectious disease, 6; and microbiology/immunology, 13. *Clinical and preventive medicine and associated topics* (79 nominations): clinical medicine, 23; clinical skills, 7; decision analysis/statistics/experimental design, 13; epidemiology, 8; psychosocial medicine, 19; and ethics/character, 9.

ethics and character, such as paternalism, ethics, and physician-patient relations.

Discussion

The challenge faced by medical educators is to accomplish two seemingly conflicting goals at once. On the one hand, the knowledge overload must be trimmed, and added responsibility must be given to students for filling out their base of medical information, perhaps with the help of better technical aids. On the other hand, some fundamental building-block concepts of medicine must be understood in depth, perhaps requiring even more intensive curricular attention. There is a tension here between the less and the more.

The current survey has provided some guidance regarding biomedical concepts that might serve as foci in a curriculum. All the concepts provided in the survey were judged to be "important to the practice of medicine"; however, there were gradations in the perceived difficulties the concepts pose to students' learning and understanding. What is perhaps most striking is the degree of agreement between basic science and clinical teachers regarding both "importance" and "difficulty." There was a strong agreement between basic scientists and clinicians on the importance of concepts, and disagreements on difficulties never involved more than 25% of the concepts. There are not "two cultures" here, one basic science and the other reflecting clinical practice; this study has identified some concepts about which there is reasonable consensus. Of course, the concepts provided in the questionnaire cannot be assumed to capture the full range of concepts that medical teaching faculty consider to be especially important and difficult. The section of the survey in which respondents nominated new concepts should aid in completing this picture.

The results of the survey can provide guidance for curriculum design or reform at two complementary levels. First, the judgments of the importance of concepts provide focus for what should receive special attention in the curriculum. Second, the judgments of the difficulty of concepts indicate which concepts are going to require "special handling"—that is, concepts that are likely to be hard for students to grasp and that may easily be misunderstood.

Some precautionary notes need to be given regarding the interpretations of the results, however, and their implications for curricular design—some of which point to the need for further research. First, the level of difficulty perceived by faculty may not be the same as the actual difficulty students encounter in understanding a concept. This problem of perception points to the need for studying, in detail, students' learning and understanding of the concepts, including the kinds of mental models[14] of the concepts they acquire. This kind of work is being undertaken by the authors and their colleagues, guided by the results of the survey.[11] Second, care must be exercised in any curricular or pedagogical response aimed at addressing areas of conceptual difficulty. For example, the seemingly reasonable pedagogical approach (one that appears often to be used) of teaching a difficult idea by starting with a simplified model and "building up" can backfire; students may not progress beyond the cognitively satisfying but overly simplified model.[11,15] This problem points to the need for research on how to teach (and learn) complicated concepts, in ways that facilitate understanding without compromising the inherent complexity itself.[16,17] Finally, educators should be aware of the extent to which entrenched misconceptions of difficult concepts are likely to exist among students and how difficult these can be to change.[18] The responses to this survey, however, indicate that not all concepts viewed as important to the practice of medicine are difficult to learn and apply. Furthermore, the guidance provided by the survey in identifying potential areas of conceptual difficulty can direct research into what characteristics make a concept difficult, the kinds of misconceptions students acquire, and pedagogical approaches that can be effective.

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Predictive Validity of the American Board of Family Practice In-Training Examination

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Abstract—Most research into the validity of graduate medical education in-training examinations has focused on construct validity and concurrent validity issues. This study examined the predictive validity of the American Board of Family Practice In-Training Examination using multivariate analysis of all U.S. family practice residents who took the certification examination in either 1987 or 1988. Results of these two certification examinations were analyzed for the cohorts of physicians who had taken in-training examinations as first-, second-, and third-year residents. Multiple regression analysis showed that the composite score, and all but one part-score, of each in-training examination were independently predictive of performance on the certification examination. This study also found that the older residents did less well on the certification exam, and that men and women each did better on selected portions of the examination. The implications of these findings for in-training examinations in other specialties and for program directors and residents are discussed. *Acad. Med.* 65(1990):454–457.

For over a quarter of a century, graduate medical education has been evaluated by in-training assessment examinations administered to residents.[1] The American Academy of Orthopedic Surgery administered the first annual in-training examination in 1961, and the American College of Physicians, the most recent organization to join this process, initiated its first examination in 1988. Presently, there are 19 medical specialty boards or specialty societies that sponsor annual in-training examinations.[2]

In undergraduate medical education, the examinations of the National Board of Medical Examiners are used to assess the performances of medical students and to provide feedback to educators. In contrast, there is no common assessment mechanism for students at the graduate medical education level. The in-training assessment examination, therefore, has evolved to meet this need within most specialties. In family practice, for example, nearly every one of the 380-plus residency programs participates in the in-training assessment process. The in-training examination (ITE) becomes a mechanism to assess the cognitive knowledge of residents within residency programs, to compare performances of residents across training levels, and to measure the performances of residents against those in comparable programs in the rest of the nation. The programmatic application of the in-training examination is also important in that it provides program directors with a means to assess the relative degrees of success of the different clinical content components of the training program (for example, do the residents do as well in surgery as they do in internal medicine, and are the composite scores in these areas similar to the national averages?) For most of these examinations, there is no determination of pass or fail.

As with all examinations, however, before one can rely on the results, it must be determined that the examination itself is valid. In-training examinations are no exception; the lit-

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Another article about in-training examinations appears on page 475.

erature contains many studies on the issue of validation. The studies most often reported, however, have been investigations of the construct validity of these examinations. This approach assumes that the examination is valid if it is able to perform in a manner consistent with expectations. Thus, if residents' performances on the in-training examination improve with increased residency experience, the examination can be said to have construct validity. A number of medical specialties have presented evidence of the construct validity of their in-training examinations.[3-12] Several of these studies have also demonstrated that residents' examination performances in clinical subspecialty areas also improve with increased training.

Studies of the concurrent validity of in-training examinations have also been reported in the literature. An examination is considered to have this form of validity if it correlates with other measures of performance. A number of researchers have investigated the concurrent validity of in-training examination by correlating examination scores with residents' ratings by faculty.[3,10,13-16] However, results of these studies have been mixed, suggesting that the correlation between ratings and examination scores is a function of who provides the ratings and whether the ratings are a global impression of clinical ability or assessments of clinical performances in specific areas.

A third approach to evaluating in-training examinations is by assessing predictive validity. Predictive validity, simply stated, is the extent to which an examination can predict the future performances of examinees. To the authors' knowledge, there have been only three reported studies of the predictive validity of in-training examinations.[13,17,18] In each, strong evidence was found that the in-training examination was predictive of subsequent performance on the Qualifying Examination of the American Board of Surgery. However, each of these studies has examined only the bivariate analysis of data from a single residency program. The purpose of the present study was to examine the predictive validity of the American Board of Family Practice In-Training Examination based upon a multivariate analysis of national data from recent certification examinations.

Method

The data examined were scores from both the in-training examination (ITE) and the certification examination of the American Board of Family Practice (ABFP). The ITE is given to family practice residents during November in each of the three years of residency training. Residents who take the ITE remain anonymous from the Board and are identified only by a code number assigned by the residency program. For this study, each U.S. family practice residency program was sent a listing of all the residents from that program who had taken the certification exam in 1987 and 1988, in order to match the residents' certification examination scores with the scores of their three in-training examinations. The results of all three in-training examinations were assembled for those cohorts of physicians who began their residencies in 1984 and 1985. The data available for each examination included a composite score and part scores for internal medicine, surgery, obstetrics, community medicine, pediatrics, psychiatry, gerontology, and gynecology.

The ABFP certification examinations, which were administered to these cohorts in July 1987 and July 1988, served as the criterion variables. All ABFP examinations are standardized to a mean of 500 and a standard deviation of 100. For the cohort entering residency programs in 1984, complete data were available for 1,392 individuals for three in-training assessment examinations and the 1987 certification examination. For the cohort beginning residency training in 1985, comparable complete data were available for 1,420 physicians. All the residents included in this analysis were taking the certification examination for the first time.

Two demographic variables were also examined. Each physician's age (in years) and gender (0 = female, 1 = male) were included in the analysis. Previous studies had identified these variables as being significantly associated with performances on medical specialty board certifying examinations.[19] The demographic variables were included in this analysis in an effort to control for their potential influences upon the relationship between performances on the in-training and certification examinations.

Data were analyzed using several statistical methods. Initially, a one-way analysis of variance (ANOVA) was conducted to verify the construct validity of the ITE. For this set of analyses, the 1986 and 1987 ITE composite and part scores served as dependent variables. A resident's year in residency training (first, second, or third) was the independent variable in each ANOVA. Differences between mean scores on the ITE were assessed for statistical significance using Fisher's protected least-significant difference (LSD) procedure.[20]

Correlation coefficients and multiple regression analysis were subsequently employed to estimate the predictive validity of the ITE. In the regression analysis, the 1988 and 1987 certification examination composite and part scores were used as dependent variables. Scores on ITEs taken during the three years of residency training were included as independent variables, along with age and gender.

As intercorrelations among examinations will suggest, the inclusion of in-training scores from all three residency years may produce problems of multicollinearity in regression equations. A number of solutions have been suggested in the methodology literature, including the exclusion of redundant variables, combining correlated independent variables into a single indicator, and the use of ridge regression techniques.[21,22] There is, however, no single best solution to this problem. Given that multicollinearity does not bias regression coefficients but only increases standard errors,[23] ordinary least-squares regression was used in this analysis.

Table 1

U.S. Residents' Mean Scores on All Parts of the 1986 and 1987 ABFP In-Training Examination (Listed by Year of Residency), with One-Way Analysis of Variance Values*

	1986 In-Training Examination				1987 In-Training Examination			
	Mean Scores, by Year of Residency				Mean Scores, by Year of Residency			
	Year 1 (n = 2,411)	Year 2 (n = 2,408)	Year 3 (n = 2,380)	Model F-Value	Year 1 (n = 2,461)	Year 2 (n = 2,406)	Year 3 (n = 2,342)	Model F-Value
Internal medicine	471.2	505.7	528.8	266.6	472.1	504.6	528.6	206.4
Surgery	478.7	500.1	524.0	130.8	469.5	504.9	529.5	236.3
Obstetrics	462.9	509.7	530.3	311.4	463.1	512.8	526.5	314.1
Community medicine	480.3	501.7	521.3	104.3	493.4	500.0	511.4	20.6
Pediatrics	476.9	500.3	526.6	156.6	465.6	503.3	535.8	326.0
Psychiatry	487.1	499.5	519.0	64.6	490.7	500.0	513.0	31.0
Gerontology	477.7	502.5	523.7	135.0	489.4	501.6	515.7	42.2
Gynecology	466.1	507.2	528.8	263.5	479.3	505.3	520.6	110.0
Composite score	453.7	506.3	544.0	580.0	468.8	505.9	534.1	427.0

*This table allows a comparison of residents' scores nationwide on the 1986 and 1987 American Board of Family Practice In-Training Examinations. The ANOVA values indicate that the average composite score performances on the examinations, as well as the mean part-score performances, vary significantly by year of residency. (Fisher's protected least-significant difference procedure indicated that the mean scores by year of residency were all significantly different at the .05 level.) See the text for additional interpretations of these scores and for their relation to the scores of the same residents on their certification examinations, taken in either 1987 or 1988.

Results

A comparison of differences in the 1986 and 1987 ITE mean scores by residency program training level is presented in Table 1. The one-way ANOVA model F-values indicate that average composite score performances on the individual examinations, as well as mean part-score performances, varied significantly by year of residency. For all scores examined, the average performance of the residents improved as residency training and experience increased. Fisher's protected LSD procedure indicated that average scores by year of residency were all significantly different at the 0.05 level for each of the nine in-training scores examined.

For both cohorts of residents, bivariate correlations between the three separate in-training examinations and the certification examination were between 0.69 and 0.75. Intercorrelations among the three in-training examinations taken by each group of residents were found to range from 0.67 to 0.75.

Regressions of the ABFP certification examination composite score upon the scores on the three in-training examinations and demographic characteristics of residents in both cohorts were next examined. Results for each cohort indicated that each in-training examination was independently predictive of performance on the certification exam. In addition, the older residents did less well on the certification examination. The residents' gender had no effect on overall examination scores in either cohort. The two equations each accounted for approximately two-thirds of the variation in composite scores on the certifying examination.

Additional regression equations were performed in order to assess the extent to which in-training part scores in eight subject areas were predictive of corresponding part scores on certifying examinations. In all but one instance, each in-training part score included in these equations was found to be predictive of the part score in the same subject area on the certifying examination. Age had the same effect on part scores as on the certification examination composite scores. Gender, however, showed some interesting variations by subject area. For the 1987 certification examination, the women performed significantly better in the obstetrics, pediatrics, and gynecology sections of the certifying examination, while the men did significantly better in surgery and community medicine. On the 1988 examination, the men performed better on the surgery component, while the women did significantly better on the psychiatry and gynecology sections. Past research has shown gender differences in medical students' performances in specific subject areas.[24] A review of the coefficients of determination (R^2) shows that the subject-area scores from the ITE were not as strongly predictive of their corresponding certifying examination scores as were the composite scores.

Summary and Conclusions

As mentioned above, in-training examinations are useful for a variety of purposes. These examinations are used as achievement tests to obtain an indication of the extent and quality of past instruction and experience. They are also useful as ability tests to obtain a measure of current residents' knowledge and as a way to measure the performances of residents nationally. In addition, they can be used to assess the quality of training received within clinical disciplines, and they function as aptitude tests to estimate or predict a resident's future examination performance. It has been an-

ticipated, though not demonstrated conclusively until this study, that there is a strong positive relationship between performance on ITEs and performance on certification examinations.

This national study has confirmed the construct validity of the American Board of Family Practice In-Training Examination: as the amount of family practice clinical training increases, so does performance on the ITE. For both the total examination and the subscore areas, performances are significantly different between training levels. Moreover, this study has confirmed statistically significant predictive validity. Performance on the family practice certification examination can be predicted from the ITE scores. In-training examinations taken during all three residency years were found to be independent predictors of certification examination scores.

These data serve as clear evidence that properly designed and administered in-training assessment examinations can accurately assess the cognitive knowledge of resident physicians. And, more important, defects in cognitive knowledge identified by the ITEs studied here may forecast difficulties on future certification examinations unless there is appropriate classroom and/or clinical educational intervention. Caution is advised; these data do not suggest that the in-training assessment examination should be used as the sole determinant of performance.

Obviously, the results of this study cannot be generalized to all in-training examinations. Nor would the authors concede that all in-training examinations are of the same quality or, for that matter, used for the same purposes. However, in-training assessment examinations are generally designed to gather information about a resident's cognitive knowledge within a designated specialty. At the conclusion of residency training the physician will take a certification examination in his or her specialty area. It would follow, therefore, that the in-training examination should predict with some accuracy residency graduates' chances for attaining board certification. For those specialty areas where predictive validity studies have yet to be done, the authors encourage such efforts. Much is yet to be learned about in-training assessments and the outcomes of such assessments.

While this paper presents evidence of the predictive validity of an in-training examination program, additional research is recommended. Given the necessity of maintaining the quality of graduate medical education, efforts to validate and improve one of the primary instruments of assessing it should be not only encouraged but expected. In addition to reports on the construct, concurrent, and even predictive validity of these examinations, other types of validation require investigation. Chief among these is the content validity of these examinations. While the validity of an examination can never be established with any degree of finality, ongoing efforts to investigate the degree to which these instruments are measuring what they are intended to measure can help contribute to that elusive goal.

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The Impact of an AIDS Symposium on Attitudes of Providers of Pediatric Health Care

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Abstract—Following reports of concern among health-care workers regarding the occupational risk of infection with the human immunodeficiency virus (HIV), a symposium was designed in 1987 to demonstrate to health-care providers at three hospitals in The Bronx, New York, the low risk of occupational HIV infection and techniques for avoiding infection. After the symposium, 103 of the health-care providers who had attended it completed a questionnaire assessing the impact of the symposium on their attitudes; the responses from 100 of these providers were used in this study. Twenty-nine of the responding providers reported that the symposium had increased their concerns regarding their risk of HIV infection; this group was composed of seven of the 15 medical students who responded, 12 of the 36 housestaff, seven of the 28 faculty, and three of the 21 other medical staff. The findings of the present study suggest that a symposium designed to decrease concerns of occupational HIV infection among health-care workers may have the opposite effect on some of those who attend it, especially medical students. Education alone may be inadequate to reassure some providers. The authors recommend small-group sessions addressing the emotional aspects of health-care providers' concerns. *Acad. Med.* 65(1990):461–463.

Throughout the evolution of the acquired immunodeficiency syndrome (AIDS) epidemic, there have been numerous reports of concern and fear on the part of health-care workers in contact with AIDS patients.[1-6] Among 263 houseofficers who were recently surveyed in New York, 48% of the medical and 30% of the pediatrics houseofficers reported moderate to major concerns about acquiring AIDS from their patients; 25% of all the respondents indicated that they would not continue to care for AIDS patients if given a choice.[4]

Health-care providers from three hospitals were involved in this study: the Bronx Municipal Hospital Center, the North Central Bronx Hospital, and the Montefiore Medical Center. They are all located in The Bronx, a borough of New York City with a population of 1.16 million people, and serve a population of children in which the seroprevalence for HIV antibodies in newborns is 2.3%.[7] In this setting, we have noted increasing concern among providers of pediatric health care regarding the risk of contracting HIV infection in the course of patient care. We have also encountered instances of decreased willingness on the part of these providers to care for children with AIDS. In response to these concerns, in 1987, the Division of Pediatric Education designed an educational program entitled "AIDS: A Symposium for the Health Care Professional in Pediatrics." One of the primary goals of the symposium was to decrease the level of concern among these health professionals by presenting data on the low risk of occupational HIV infection along with a discussion and demonstration of techniques to avoid occupational HIV infection. In addition, we sought to increase the willingness of providers to care for children with AIDS.

In the present report we describe the impact of the symposium as reported by the attendees on their concerns, practices, and willingness to care for children with AIDS.

Method

The symposium was widely advertised in order to attract the greatest possible number of participants. The following paragraphs present an overview of the symposium and the questionnaire we designed to evaluate it.

The AIDS Symposium

The symposium consisted of three presentations one week apart, each 90 minutes long. The series began with an update on the epidemiology and modes of transmission guidelines and techniques for preventing HIV infection in the hospital. The third session focused on the psychosocial and ethical issues encountered in treating children with AIDS. The content of the presentations varied, and they included lectures, a panel discussion, and an emotional plea by a houseofficer encouraging her colleagues to use gloves for all invasive procedures.

Evaluation

Prior to the symposium, we developed a questionnaire to assess the efficacy of the program in decreasing concerns among the attendees regarding caring for AIDS patients. We distributed the questionnaire at the beginning of the third lecture. It was designed to test the following hypotheses:

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Other articles about the effects of AIDS on educating health-care providers appear on pages 446, 458, 464, 467, 470, 472, and 482.

Table 1

Numbers and Percentages of 100 Pediatrics Health Professionals of Different Levels of Training Whose Attitudes toward Treatment of AIDS Patients Did or Did Not Change after an Educational Symposium on AIDS, Bronx Municipal Hospital Center, 1987*

Attitude and Response	Medical Students		House-staff		Faculty		Other Medical Staff		All Respon-dents	
	No.	%	No.	%	No.	%	No.	%	No.	%
Perceived personal risk of occupational HIV infection										
No change	8	53	22	61	20	71	13	62	63	63
Increased risk	7	47	12	33	7	25	3	14	29	29
Decreased risk	0	0	2	6	1	4	5	24	8	8
No response	0		0		0		0†		0†	
Total	15	100	36	100	28	100	21	100	100	100
Willingness to care for future AIDS patients										
No change	14	93	31	86	24	86	17	81	86	86
Increased	0	0	4	11	0	0	4	19	8	8
Decreased	1	7	1	3	4	14	0	0	6	6
No response	0		0		0		0†		0†	
Total	15	100	36	100	28	100	21	100	100	100
Intended to take precautions in future										
No change	3	20	10	28	15	54	11	52	39	39
Increased precautions	12	80	26	72	13	46	10	48	61	61
Decreased precautions	0	0	0	0	0	0	0	0	0	0
No response	0		0		0		0†		0†	
Total	15	100	36	100	28	100	21	100	100	100

*A symposium was given to pediatric health-care providers, in part to present data demonstrating the low risk of occupational HIV infection and techniques for avoiding infection. The results presented in this table suggest that such a symposium, presented to decrease concerns, may have the opposite effect on some of those who attend it.

†One person in this "other medical staff" group did not respond, but for other reasons the other data provided by that person had to be excluded from the study results.

1. Attendance at the symposium would decrease the attendees' concerns regarding their personal risks of becoming infected with human immunodeficiency virus (HIV) as a result of patient care.
2. Attendees would report that they intended to increase the routine precautions they would take to avoid HIV infection during the course of patient care.
3. Attendance at the symposium would increase the participants' willingness to care for AIDS patients in the future.

Statistical Analysis

The questionnaires were scored on a three-point Likert scale. Chi-square analysis with the Yates' continuity correction as well as two-tailed Fisher's exact test (FET) and McNemar's binomial test was used for 2×2 contingency tables as appropriate.

Results

Given our desire to evaluate the impact of this symposium on health-care providers with different levels of training, it was gratifying to see the diversity among those who attended, as described in the following paragraphs.

Respondents

A total of 103 health-care providers completed the questionnaire, of whom 88 attended two or three sessions in the series, while 15 attended one session only. Data from three of the respondents were not usable for this study.

As shown in Table 1, the respondents, categorized by level of training, included 15 medical students, 36 housestaff (including fellows and chief residents), 28 faculty, and 21 other medical staff (nurses, social workers, and administrative personnel). Sixty-nine were women and 50 were between 21 and 30 years of age; the remaining respondents were older.

Respondents' AIDS Experience

Fifty eight of the respondents reported having cared for ten or fewer patients with AIDS over the previous five years, while 45 had cared for more than ten AIDS patients in that period. Twenty-four respondents reported having had percutaneous exposure to the blood or secretions of an AIDS patient, while 75 denied having such exposure (four subjects did not respond). Of the 24 respondents reporting percutaneous exposure there were two (8%) medical students, 12 (50%) housestaff, nine (38%) faculty, and one (4%) other medical staff members. By level of training, 35% of the housestaff, 32% of the faculty, 13% of the medical students, and 5% of the other medical staff reported

percutaneous exposure to the blood or secretions of an AIDS patient.

The Symposium's Impact

The respondents were asked, "as a result of this symposium, have your concerns changed regarding your personal risk of becoming infected with HIV as a result of patient care activities?" Twenty-nine (29%) of the respondents reported increased concern about their personal risks of HIV infection. Increased concern was related inversely to level of training. Decreased concern was noted by less than 4% of the medical student, faculty, and housestaff groups combined. Within the other medical staff group, 24% reported decreases in their concerns ($p < .01$ by FET).

Sixty-one of the respondents (including 80% of the medical students and 72% of the housestaff) reported that as a result of the symposium they planned to increase the precautions they would take to avoid HIV infection when providing patient care in the future. The remaining 39 respondents reported that the symposium had no effect on the precautions they would take during future patient care. None stated they would decrease their precautions. Persons with increased concerns with regard to occupationally acquired HIV infection were far more likely to report intentions to increase precautions in the future ($p < .001$ by McNemar test).

Eighty-six of the respondents reported that as a result of the symposium, their willingness to care for AIDS patients in the future had not changed. Six respondents (four faculty, one houseofficer, and one medical student) felt the symposium had made them less willing to care for future AIDS patients. Of these six, none had a history of percutaneous exposure to the secretions of an AIDS patient, and only one had cared for more than ten patients with AIDS. All six reported both increased anxiety and increased concern about occupational HIV risk as a result of attending the symposium.

Discussion

The present study illustrates that an educational program designed to decrease concerns regarding occupational acquisition of HIV infection and increase willingness to care for AIDS patients may have the opposite effect on the attendees. Although the symposium was designed with a goal of alleviating concerns regarding occupational HIV infection, it served to increase concerns in almost 30% of the attendees.

With the not-unexpected finding of increased risk perception among students and houseofficers, another goal of the symposium was to encourage participants to increase the precautions they would take to avoid HIV infection while caring for all patients. Over 60% of the respondents reported that as a result of the symposium they intended to increase precautions during patient care. Medical students, the group with the greatest concern about HIV infection, were the most likely to report an intent to increase precautions as a result of the symposium.

Despite an increase in general anxiety and concerns about personal risk, 86% of the respondents reported that their willingness to care for AIDS patients in the future was unchanged. Nevertheless, these findings suggest that dissemination of information alone may be inadequate in addressing the concerns, both warranted and unwarranted, among health-care workers who care for patients with AIDS.[8] More data are needed that define the specific aspects of an AIDS educational curriculum that are most effective in changing attitudes and behaviors, reducing anxiety, and disseminating technical information. Approaches to AIDS education that address emotional aspects of health-care problems and provide support for health-care providers — with specific targeting of medical students — should be explored.[8] A prospective evaluation of the effect of such a symposium on actual rather than intended behaviors may be valuable in planning and evaluating future programs.

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Attitudes of Medical School Faculty and Students toward Acquired Immunodeficiency Syndrome

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Abstract—Attitudes of faculty and students will influence the success of educational programs to address acquired immunodeficiency syndrome (AIDS). In 1988–89, 170 medical school faculty and 227 students completed needs assessment questionnaires at the University of Louisville, and the results were compared to assess the respondents' attitudes about AIDS. Both the faculty and the students were found to be fearful of infection, had strong negative attitudes toward AIDS patients, and had low levels of confidence in the current knowledge about AIDS. Both cognitive and affective training strategies are recommended to help learners distinguish unwarranted from warranted fears of infection and to increase their empathy for patients with AIDS. *Acad. Med.* 65(1990):464–466.

Acquired immunodeficiency syndrome (AIDS) has reached epidemic proportions, with over 450,000 cases projected to exist in the United States by 1993.[1] This magnitude of cases makes it imperative that physicians be well trained regarding this illness; to accomplish this presents a major challenge to medical educators.

Several studies have reported negative attitudes toward AIDS patients and homosexual patients among physicians, housestaff, registered nurses, and medical students.[2–6] Fear of contagion and homophobia greatly affected the attitudes reported in these studies. To further examine these findings, the AIDS Health Education Program of the University of Louisville's Department of Psychiatry and Behavioral Sciences, which provides AIDS training to health-care providers, surveyed all medical school faculty and students regarding their attitudes about AIDS. To our knowledge, this is the only such survey at a medical school in the United States.

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Other articles about the effects of AIDS on educating health-care providers appear on pages 446, 458, 461, 467, 470, 472, and 482.

Method

A needs assessment was sent to 248 faculty and 485 students at the University of Louisville School of Medicine during the 1988–89 academic year. A total of 170 faculty and 227 students returned the questionnaire (response rates of 69% and 47%, respectively). The current report compares the responses made by these faculty and students to 20 attitude items related to three primary areas: (1) HIV transmission and fear of contagion; (2) feelings about AIDS and homosexuality; and (3) legal and ethics issues related to the care of patients with AIDS.

Responses were scaled as follows: 0 = no opinion; 1 = strongly disagree; 2 = disagree; 3 = agree; and 4 = strongly agree. In order to compare the responses of the faculty and students to these 20 items, chi-square analyses were performed using three categories: "No opinion;" "yes" (created by adding all "agree" and "strongly agree" responses); and "no" (created by adding "disagree" and "strongly disagree" responses). Acceptance of significant differences was based on an alpha level of .05. Trends toward significance, however, are noted if $p < .10$.

Results and Discussion

The mean age of the faculty members in our sample was 45.1 years and that of the students was 26.3 years. More of the faculty were men and married than were the students.

The responses to the 20 attitude items, presented in Table 1, indicate that at the time of our study large numbers of the faculty and students surveyed (1) were fearful of infection; (2) felt uncomfortable dealing with AIDS patients; (3) had negative attitudes and biases toward those with AIDS; and (4) experienced confusion and discomfort when confronted with the legal and ethics issues associated with AIDS. Very little difference in attitudes was found between the two groups. The responses to only two items showed significant attitude differences ($p \leq .05$), and the differences shown by the responses to another four items approached significance. In reviewing these six items, it appears that the students were more fearful of infection and felt more strongly that physicians should have the right to refuse treatment to persons with AIDS. On the other hand, the students were more sensitive to AIDS patients' right to die and to the problems of widespread HIV testing.

A number of factors may account for the similarities in responses of the two groups. Since criteria for medical school selection are determined by the faculty, the students selected are likely to share many attitudes held by the faculty. Faculty also serve as role models, influencing students' views of clinical, social, and ethics issues. Finally, the attitudes of both students and faculty tend to mirror those of

Table 1

Percentages of Faculty and Students Who Said "Yes," "No," or Had No Opinion in Response to 20 Items Concerning Their Attitudes toward Aspects of AIDS; University of Louisville School of Medicine, 1988–89*

	Faculty				Students				
Item	*n*	% Yes	% No	% No Opinion	*n*	% Yes	% No	% No Opinion	*p*
Have knowledge to protect self from AIDS	170	87.6	11.2	1.2	226	91.2	8.4	0.4	‡
Would prefer to avoid caring for PWA†	170	50.6	40.0	9.4	225	43.6	48.4	8.0	‡
Health providers should be able to refuse care for PWA†	170	33.5	59.4	7.1	217	45.1	48.2	6.6	<.07
Feel am at risk getting AIDS because of job	170	16.5	80.6	2.9	226	26.1	71.7	2.2	<.08
Sought opportunity to work with PWA†	170	7.6	66.5	25.9	226	13.7	69.9	16.4	<.03
Feel comfortable conversing with PWA†	170	88.8	10.0	1.2	226	87.2	9.3	3.5	‡
Feel comfortable shaking hands with PWA†	170	83.5	14.7	1.8	225	86.2	12.0	1.8	‡
Feel comfortable sharing house with PWA†	169	33.7	56.8	9.5	226	33.2	60.6	6.2	‡
Feel more negative about homosexuality since AIDS	169	29.6	63.3	7.1	226	34.5	58.8	6.6	‡
Believe working with PWA† could give AIDS to family	169	23.7	69.2	7.1	226	25.2	68.6	6.2	‡
Believe could get AIDS while providing routine care to PWA†	170	25.3	65.3	9.4	226	39.4	58.0	2.7	<.001
HIV testing should be done only with informed consent	170	42.9	50.0	7.1	225	32.4	61.8	5.8	<.07
Terminally ill PWA† have right to electively terminate lives	169	58.6	29.6	11.8	226	65.9	24.3	9.7	‡
Would assist terminally ill PWA† in electively ending live	169	16.0	72.8	11.2	226	25.2	63.7	11.1	<.09
Physician should give HIV test to patient if thinks patient engaging in unsafe sex	168	45.2	47.0	7.7	226	43.8	49.6	6.6	‡
Concerned that in future will find AIDS transmitted in ways now thought safe	170	51.8	38.8	9.4	226	56.6	34.1	9.3	‡
Government should distribute needles to prevent spread of AIDS	169	40.2	46.2	13.6	226	37.6	54.0	8.4	‡
All patients admitted to hospital should be HIV-tested	169	47.9	48.5	3.6	225	39.1	56.4	4.4	‡
PWA† engaging in unsafe sex should be incarcerated	169	63.3	28.4	8.3	226	68.6	22.6	8.8	‡
Rights of PWA† have been overemphasized	170	40.6	46.5	12.9	225	33.3	52.0	14.7	‡

*A needs assessment was sent to 248 faculty and 485 students; 170 of the faculty (69%) and 227 of the students (47%) returned it. The table presents the responses to 20 items concerning attitudes about HIV transmission and fear of contagion, feelings about AIDS and homosexuality, and legal and ethics issues related to HIV infection. As the table indicates, a few faculty and students did not respond to certain items.

†Patients with AIDS.

‡Difference between responses of students and faculty not significant.

the community at large, where fear of infection and homophobia are prominent.

Conversely, there are also several possible reasons why the students and faculty differed in their attitudes about AIDS. Fear of infection would be expected to be greater among students, who have less medical education. On the other hand, faculty in certain specialties or in the basic sciences are less likely to seek opportunities to work with AIDS patients by virtue of their chosen fields. The attitudes of clinical versus preclinical faculty about AIDS merit further study. Finally, by virtue of age and generational differences, students are likely to view social and ethics issues differently from the way their older faculty counterparts view them.

While there was a general feeling that the groups had enough knowledge to protect themselves from infection, there remained concern that working with AIDS patients carried risk. These concerns probably influenced many to avoid working with persons with AIDS, and to feel that they should be able to refuse to treat AIDS patients. This finding is important because reluctance to work with AIDS patients has the potential for negative impact on the quality of care provided.

Although the majority of both faculty and students said they felt comfortable conversing with or shaking hands with a patient with AIDS, a minority said they would feel comfortable living in the same house with someone with AIDS. This difference may reflect an association between degree of discomfort and closeness of contact and therefore an underlying fear of infection. To what extent homophobia or other stigmas such as illegal drug use, which are commonly associated with persons with AIDS, influenced the responses to this item is not known and obviously warrants further study. The concern that future modes of HIV transmission will be found also reflects an underlying fear of infection and implies a low level of confidence in the current knowledge about AIDS. Other studies

have also shown that fear of infection is an overriding concern among physicians and medical students.[4,7]

That one-third of those surveyed felt more negatively about homosexuality as a result of AIDS supports findings that have been reported elsewhere.[2-5] These feelings will present significant problems for physicians treating patients who became infected as a result of homosexual behavior. In addition, the fact that over one-third of those surveyed felt that the rights of AIDS patients had been overemphasized represents a potential source of resistance to training efforts and is disturbing because more faculty than students felt this to be true. Faculty may thus feel ambivalent about including AIDS in the curriculum. Although the confidentiality of the survey results was guaranteed, negative feelings about AIDS may also have resulted in our relatively low return rates, particularly among the students.

Our findings have several implications for curriculum design and development. First, AIDS training efforts need to address both the warranted and the unwarranted fears that medical students and faculty may have about working with patients with AIDS. Lectures should include information about the actual risks involved in patient care activities that involve exposure to infected blood and ways that such exposure can be prevented. However, training should include affective as well as cognitive training strategies to help learners process the information being presented and to help alleviate unwarranted fears of HIV transmission from casual contact. We have found small-group discussions, which allow health-care providers to share their doubts and fears with colleagues, to be effective in this regard.

Likewise, increasing comfort levels through interactions with AIDS patients is very important. Personalizing this illness for physicians and students would increase empathy for AIDS patients and offset the tendency to stigmatize those with AIDS.[8] Considerable attention also needs to be devoted to the legal and ethics issues related to the care of patients with AIDS, as well as to issues regarding homosexuality and homophobia. Finally, training efforts need to be directed at faculty as well as students, because the two groups share many of the same negative attitudes.

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Medical and Nursing Students' Attitudes about AIDS Issues

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Abstract—A 12-item questionnaire was administered in late 1987–early 1988 to 445 medical students, 133 medical school applicants, and 111 nursing students to assess any differences in their attitudes toward medicine-related AIDS issues. These groups were also given a 31-item test of their knowledge of AIDS issues. Significant differences by levels of knowledge were obtained for eight of the 12 attitude items. For example, the more knowledgeable the student, the less likely he or she was to refuse treatment to an AIDS patient, to require mandatory AIDS testing of physicians, or to require medical personnel to wear gloves. The findings strongly suggest that education has an important role in changing attitudes about AIDS in a direction that fosters better health care for AIDS patients. *Acad. Med.* 65(1990):467–469.

Today's students in the health professions can expect to encounter AIDS patients with ever-increasing frequency even in the early years of their professional careers. The attitudes that these future health-care providers develop towards the disease AIDS and towards individuals with AIDS will ultimately affect their ability to provide competent and compassionate care to AIDS patients.

Recently, a number of surveys and questionnaires have been developed to gather attitudinal information about AIDS from a broad range of subject groups including physicians,[1–3] health-care providers,[4] and college students.[5–7] The domains covered by these investigators include the availability of information about AIDS and information sources,[6] misconceptions about casual transmission of AIDS,[4–7] fear of AIDS,[6] and attitudes toward homosexuality.[2,5,8] The authors have found few articles that compare the attitudes of health-professions students toward AIDS-related medical issues. The present article reports the results of a survey designed to assess current and future medical students' and current nursing students' attitudes toward the medical issues related to AIDS. The authors chose this topic because the competent and compassionate care of AIDS patients requires that two of the key members of the health-care team—the nurse and the physician—understand while still in training the conflict arising from possible differences in their attitudes towards AIDS health-care issues.

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Other articles about the effects of AIDS on educating health-care providers appear on pages 446, 458, 461, 464, 470, 472, and 482.

Method

A 12-item questionnaire was developed, drawing from items included in an opinion poll of internal medicine specialists.[9] The students were asked to indicate whether they agreed or disagreed with each of the 12 statements, which were designed to elicit their attitudes about AIDS issues and were part of a larger instrument to assess students' knowledge about these issues, administered between October 1987 and January 1988. Members of three major student health-care provider groups were surveyed: (1) 133 applicants to medical school at the time of their on-campus interviews at the Medical College of Wisconsin; (2) 445 first-, second-, and third-year medical students at that school; and 111 second-year (preclinical) nursing students at the University of Wisconsin–Milwaukee, School of Nursing. (Hereafter in this article, all these types of providers are referred to as "the students" when the entire group is being indicated.) All the students in each group voluntarily completed the questionnaire, during regularly scheduled class time, at registration, or during free time on medical school interview days. The responses were given anonymously and coded only by cohort status.

Three analyses were performed. First, response frequencies were calculated. Second, chi-square tests of association were conducted to determine whether there were significant differences between the responses of the groups. Third, $3 \times 3'$ chi-square tests of association were conducted to determine whether there were any significant relationships between the students' knowledge about AIDS and their opinions about it. The students' knowledge about AIDS was ascertained by their performances on a 31-item test that assessed five AIDS-related knowledge domains: epidemiology, risk factors, signs and symptoms of clinical illness, mechanisms of transmission, and testing and interpretation. The responding students were classified into one of three groups based on their knowledge of AIDS: those who answered 74% or more of the items correctly were placed in the "high" group ($n = 216$); those who answered between 61% and 71% of the items correctly were placed in the middle group ($n = 325$); and those who answered 58% or less of the items correctly were placed in the low group ($n = 175$).

Results

For each item in the attitudes questionnaire, the proportion of the students who agreed with the statement (by marking "yes") was calculated. The students' agreement on re-

Table 1

Percentages of Medical Students, Medical School Applicants, and Nursing Students Who Answered "Yes" to 12 Questions about AIDS Issues, Medical College of Wisconsin, 1987–1988*

Questions	Percentage Answering "Yes"			
	Medical Students ($n = 445$)	Applicants ($n = 133$)	Nursing Students ($n = 111$)	All Students ($n = 689$)
Do you believe you have the right to refuse to treat AIDS patients?†	66	37	58	59
Would you refuse to treat AIDS patients?†	22	8	19	19
Should AIDS testing be mandated for some groups?	78	75	87	79
Should physicians be tested for AIDS?†	66	70	89	71
Would you restrict people with AIDS from the following occupations:				
Medical personnel?‡	53	49	66	55
Food handlers?	55	46	60	54
Teachers?	13	8	17	13
Occupations with wide-spread public contact?	23	13	11	15
Would you inform an AIDS patient's sexual partner against the patient's wishes?†	76	66	58	70
Should dental and medical personnel be required to wear gloves?	79	77	87	80
Do you believe that life and health insurance companies have the right to test applicants?	50	46	54	50
Should experimental drug testing rules be relaxed?†	81	75	53	75

*The authors administered these questions to the students and applicants in these three groups; all those who were surveyed completed the questionnaire. These responses were analyzed regarding the differences of attitudes between the groups and how the attitudes differed according to the respondents' levels of knowledge about AIDS issues, ascertained by a separate 31-item test. These responses were also compared with the responses on a similar opinion poll of internal medicine specialists.

†$p < .01$.

‡$p < .05$.

sponses was defined as either less than or equal to 20% of the students selecting the "yes" option, or greater than or equal to 80% or more of the students selecting that option. Using this criterion for agreement, the students in all three groups agreed on only three of the 12 items. Only 13% of the students felt that AIDS patients should be restricted from teaching; 15% felt that AIDS patients should be restricted from other occupations with widespread public contact. Eighty percent of the students felt that medical personnel should be required to wear gloves (see Table 1).

There was significant disagreement among the groups on six of the 12 attitude items. For example, more of the medical students felt that they had a right to—*and* would—refuse to treat an AIDS patient than did the nursing students or the medical school applicants. The medical students were also less likely than were the nursing students or the medical school applicants to feel that physicians should be tested for AIDS or that physicians with AIDS should be restricted from the practice of medicine (see Table 1).

We then grouped all the respondents according to their knowledge levels: low, middle, and high. (The resulting findings, which follow, are not found in Table 1.) Significant differences in responses according to the students' levels of knowledge were obtained on eight of the 12 attitude items. Four of these items were significant at the $p < .05$ level: the students who were more knowledgeable were less likely to refuse to treat an AIDS patient, to require mandatory testing, or to restrict AIDS patients as teachers, and would be more likely to inform a partner against the wishes of the patient. The other four attitude items achieved significance at the $p < .01$ level: the more knowledgeable students would be less likely to test physicians for AIDS, restrict AIDS patients from occupations with pubic contact, or require medical personnel to wear gloves. They would be more likely to relax restrictions on drugs for those substances that may cure or treat AIDS but that are untested.

Discussion

To provide compassionate, humane care to AIDS patients and carriers of the AIDS virus, physicians and nurses need to be knowledgeable about the disease AIDS and be aware of their attitudes toward AIDS and AIDS patients. In this survey of health-care-professions students, it was found that the more knowledgeable students had attitudes that showed a greater willingness to care for AIDS patients and less fear of these patients. The more knowledgeable students were also less support-

ive of mandatory testing of some groups and would not restrict AIDS patients from working in non-medicine-related occupations or with the public. The more knowledgeable students would also be less likely to require gloves and more willing to relax experimental drug rules.

It is interesting that more of the nursing students than the medical school applicants or the medical students indicated that they would test physicians for AIDS (89%, 70%, and 66%, respectively). In comparing these responses to this issue with practicing internists' responses on the same issue (obtained by the opinion poll on which the attitude questionnaire was based), this trend of lessening percentages continued, with only 39% of the practicing physicians stating that it was appropriate to test their colleagues for AIDS.[9]

In other areas, the medical students and nursing students appear to have responded more like their practicing internist colleagues, and less like the medical school applicants. For example, more of the medical students (66%) than the preclinical nursing students (58%) or medical school applicants (37%) felt they had the right to refuse to treat AIDS patients. In the internist survey, 55% of the respondents felt that they had the right to restrict treatment.[9] Twenty-two percent of the medical students, 19% of the preclinical nursing students, 15% of the internists, and 8% of the applicants said they would actually refuse treatment. The practicing internists, however, had different opinions relevant to the issue of patient confidentiality. Only 49% of the practicing internists would inform a patient's sexual partner against the patient's wishes, in contrast to 76% of the medical students, 66% of the medical school applicants, and 58% of the nursing students.

In regard to the attitude differences between the groups surveyed, it is clear that the nursing and medical students in training did have different opinions on medicine-related AIDS issues, but not in the areas regarding the right to refuse to treat or their willingness to treat AIDS patients. In contrast, the medical school applicants did differ significantly from their future colleagues on these issues.

The contrasting opinions of the medical school applicants and the finding that the more knowledgeable students had a greater willingness to care for AIDS patients, and less fear of them lends strong support to the role of education[3,10] as a method of relieving unwarranted fears of future members of the AIDS patient's health-care team.

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Willingness of Health-Professions Students to Treat Patients with AIDS

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Abstract—This 1988–89 survey of 319 students in the medical, dental, nursing, and allied health-care professions revealed that over one-third had some reservations about treating acquired immunodeficiency syndrome (AIDS) patients. Most were unwilling to perform mouth-to-mouth resuscitation on patients with AIDS, and most also believed that health-care workers had the right to refuse care to AIDS patients. Unwillingness to treat AIDS patients was strongly associated with homophobic attitudes and concerns that patients with AIDS posed a risk to health professionals. AIDS education for health professionals should emphasize methods for the prevention of HIV infection among health workers, and include teaching strategies designed to deal with the irrational feelings that AIDS often engenders. *Acad. Med.* 65(1990):472–474.

Recent reports suggest that between 25 and 55% of nurses and physicians may be reluctant to work with patients with acquired immunodeficiency syndrome (AIDS) because of concerns over contagion.[1–4] In spite of the demonstrated low risk of occupational human immunodeficiency virus (HIV) infection among health-care workers,[5] some health-care personnel have refused to treat AIDS patients,[6] while others have experienced apprehension, reduced empathy for AIDS patients, and prejudicial attitudes toward homosexuals and drug abusers.[7–10] This paper is an empirical description of the attitudes of a group of students in the medical, dental, nursing, and allied health-care professions toward AIDS patients and their care.

Method

During the 1988–89 academic year, all first-year medical and dental students, junior-year nursing students, and junior-year physician assistant and physical therapy students training at a Southeastern university medical center treating AIDS patients were asked to anonymously complete a questionnaire dealing with their attitudes toward the care of AIDS patients and related issues. Because the medical and dental students completed the survey at the same time and did not distinguish their individual professions on the questionnaire, the two groups had to be combined for statistical purposes.

The questionnaire assessed the students' willingness to treat AIDS patients, their understanding of the basic epidemiology of AIDS, perceptions of the risk of AIDS transmission in the medical care environment, and attitudes about ethical issues surrounding AIDS care. Of 393 questionnaires, 319 were returned, for an overall response rate of 81.2%.

Results

As shown in Table 1, the majority of the students indicated that they would be willing to treat patients with AIDS. However, over one-third expressed some reservations—16.9% said they would not work with AIDS patients if given a choice, and 23.8% were uncertain about working with such patients if they had a choice. The percentages of those who were willing to work with AIDS patients were similar for all of the health professions sampled. Those willing and those unwilling to treat AIDS patients were also similar in age, gender, ethnic background, and marital status.

Virtually all the students understood the pathogenesis of AIDS and correctly identified the major risk factors and modes of transmission for the infection. However, less than half of those surveyed felt that they had learned enough about AIDS during their professional education to work safely with AIDS patients. The medical-dental student group appeared to be least comfortable with their AIDS knowledge. Among all the respondents, there was no statistically significant relationship between knowledge of AIDS epidemiology and willingness to treat AIDS patients.

A surprisingly large number of the students (21.6%) believed that health professionals were at high risk for AIDS. Most were inclined to take the precautions of wearing either gloves or a mask or both when performing procedures and providing routine care to patients with AIDS. Only 24.1% were willing to perform mouth-to-mouth resuscitation on AIDS patients.

Overall, most of the students (71.2%) believed that by working with AIDS patients they were placing their own health in jeopardy. Over half felt that health-care workers should have the right to refuse care to AIDS patients, and 66.8% believed that all patients (especially homosexuals and intravenous drug abusers) should be tested for AIDS when admitted to hospitals. Not surprisingly, those unwilling to treat AIDS patients were more likely to have these options. Those unwilling to treat AIDS patients were also three times more likely to believe that AIDS patients should be treated only in special hospitals and clinics.

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Other articles about the effects of AIDS on educating health-care providers appear on pages 446, 458, 461, 464, 467, 470, and 482.

Table 1

Percentage of 319 Health-Professions Students Who Answered "Yes" to Various Questions about Their Attitudes toward Treating Patients with AIDS, 1988–89*

Question	Percentage of Students Answering "Yes"						
		Students Listed by Their Health Profession ($n = 319$)				Those Willing to Treat AIDS Patients‡ ($n = 190$)	Those Unwilling to Treat AIDS Patients‡ ($n = 54$)
	All Students ($n = 319$)	Medical-Dental† ($n = 151$)	Nurse ($n = 83$)	Physician Assistant ($n = 58$)	Physical Therapist ($n = 27$)		
If given a choice, would you be willing to treat patients with AIDS?	59.6	51.7	67.5	74.1	48.1	100.0	0
If given a choice, would you be willing to treat homosexuals?	71.5	67.6	77.1	77.6	63.0	95.8	16.7§
If given a choice, would you be willing to treat IV drug abusers?	72.7	67.6	79.5	81.0	63.0	93.7	29.6§
Would you be willing to perform mouth-to-mouth resuscitation on an AIDS patient in respiratory arrest?	24.1	27.8	20.5	20.7	22.2	31.6	7.4§
Has your professional education provided you with enough information to work safely with AIDS patients?	46.1	24.5§	73.5	55.2	63.0	50.5	46.3
Are you concerned that working with AIDS patients may endanger your health?	71.2	76.8	66.3	63.8	70.4	60.0	98.2§
Should health-care workers have the right to refuse working with AIDS patients?	53.9	51.7	62.7	37.9‖	74.1	44.2	81.5§
Should hospitals be able to terminate employment of health professionals who refuse to work with AIDS patients?	19.4	19.9	15.7	25.9	14.8	24.7	3.7§
Should AIDS patients be treated only in special hospitals and clinics?	28.8	35.1	15.7	24.1	44.4	20.0	63.0§
Homosexuals who have AIDS deserve their fate because of their lifestyles.	10.0	9.3	12.1	10.3	7.4	6.3	25.9§
I am sympathetic to the fear and misery AIDS has caused the gay community	69.9	67.6	73.5	70.7	70.4	76.8	57.4§
Homosexuals should have the right to practice their sexual preferences as they choose.	69.9	69.5	72.3	72.4	59.3	78.4	40.7§

*In 1988–89, 319 students in the medical, dental, nursing, and allied health-care professions at a university medical center in the Southeast anonymously completed a questionnaire that elicited their attitudes toward the care of AIDS patients and related issues.

†The medical and dental students did not note their individual professions on the questionnaire; thus, the responses of these two groups have been combined.

‡Only 244 of the students gave a definite answer (that they either were willing or were unwilling to treat AIDS patients); the others answered "unsure."

§Statistically significant differences in "yes" responses among the students in the different health professions, and between those willing and unwilling to treat AIDS patients, chi-square comparison indicates that $p < .001$.

‖Statistically significant differences in "yes" responses among the students in the different health professions, and between those willing and unwilling to treat AIDS patients, chi-square comparison indicates that $p < .01$.

The majority of the students expressed compassion for the gay community's struggle with AIDS, and believed that homosexuals had the right to practice their sexual preferences as they chose. Only 10% felt that homosexuals with AIDS deserved their fate because of their lifestyles. However, those unwilling to treat AIDS were more likely to have had homophobic opinions than those willing to treat the disease.

Conclusions and Discussion

Students in this study had many of the same concerns about AIDS care reported by other health professionals.[1-4,7-10] In particular, they expressed fear of contagion and perceived themselves to be at increased risk when working with AIDS patients. Caution should be exercised in attempting to generalize from this study, however, since it did not involve a random sample, and because it is likely that students in other regions of the country—with more or less exposure to AIDS patients—would have different perceptions of risk.

Written comments provided by the students at the end of the questionnaire indicated that some of the anxiety over occupational HIV infection may have stemmed from perceived inconsistencies in the way information

about AIDS was being presented in the classroom, and skepticism about what was being reported in the scientific literature about AIDS. For example, one student cited two different instructors quoting widely differing rates of HIV infection among health-care workers exposed to needlesticks. Another student viewed as contradictory the facts that the human immunodeficiency virus had been detected in saliva, but saliva was not capable of transmitting the infection.

It is alarming that only about 25% of the students surveyed would have been willing to perform mouth-to-mouth resuscitation on AIDS patients. However, written comments seemed to suggest that many experienced some conflict over this issue. While recognizing their obligation to intervene in an emergency to save a life, some nonetheless felt that this obligation was outweighed by the necessity not to hazard their own lives. Others rationalized their decision by questioning the wisdom of resuscitating a patient with an incurable terminal disease.

Overcoming irrational fear of AIDS among health-professions students will be easier if instructors keep information on AIDS current and avoid anxiety-provoking inconsistencies and "mixed messages" when presenting facts about the disease—especially facts dealing with the safety of working with AIDS patients. While students should be made aware of the dangers inherent in exposure to any infectious disease, they should also understand that adherence to procedures such as the Universal Precautions can significantly reduce risks of contagion when treating patients with AIDS.[11]

To help allay fear and modify attitudes about AIDS patients greater emphasis needs to be placed on ethics and human values in health-care curricula to help students prepare for the affective aspects of caring for AIDS patients. Discussion groups or role-playing exercises guided by experienced clinicians may help students vent fears of death and deal with the discomfort often associated with the topics of sexually transmitted diseases and homosexuality. It might also be instructive to invite volunteer AIDS patients and members of their families into the classroom to help underscore the humanity of AIDS patients.

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AAMC DATA REPORT

Graduating Medical Students' Debt and Specialty Choices

The average debt level of indebted respondents to the AAMC Graduation Questionnaire is reported here for each of the specialty career choices of senior medical students in 1986 and 1989. The reported debt combines premedical educational debt and medical school educational debt. Table 1 shows for each specialty the percentages of respondents with debts and their average debts in 1986 and 1989, as well as the percentage increase in average debt for indebted students over these years.

Between 1986 and 1989, the average debt level for indebted students rose from $33,499 to $42,374. This increase of 26.5% is more than twice the 13.1% inflation in the consumer price index over that time.

In 1986, seniors with specialty career choices in general pediatrics, ophthalmology, radiology, general and subspecialty internal medicine, pathology, physical medicine, general surgery, and family practice had the lowest average debt levels. In 1989, graduating students with specialty choices in general pediatrics, pathology, urology, family practice, general surgery,

Table 1

Average Debt and Percentage of Graduating Medical Students with Debt, and the Percentage of Increase in Average Debt, AAMC Graduation Questionnaire, 1986 and 1989

	1986		1989		
Specialty	Ave. Debt of Indebted Respondents	% with Debt	Ave. Debt of Indebted Respondents	% with Debt	Percent Increase in Ave. Debt, 1986–1989
Anesthesiology	34,241	86.1	41,901	84.0	+22.4
Dermatology	34,053	77.9	39,390	74.3	+15.6
Emergency medicine	37,637	86.9	48,709	83.3	+29.4
Family practice	33,326	84.6	41,005	84.8	+23.0
General internal medicine	31,630	82.4	43,355	82.8	+37.1
Internal medicine subspecialties*	31,916	80.8	43,602	82.5	+36.6
Neurological surgery	36,670	77.9	43,940	81.3	+19.8
Neurology–child neurology	36,176	75.7	45,144	79.3	+24.8
Obstetrics-gynecology and subspecialties†	34,918	84.1	45,757	81.7	+31.0
Ophthalmology	30,232	78.2	39,140	75.5	+29.5
Orthopedic surgery	34,700	81.2	42,340	79.1	+22.0
Otolaryngology	34,278	84.5	42,164	80.7	+23.0
Pathology	32,874	76.1	38,041	78.2	+15.7
General pediatrics	30,065	80.7	37,709	82.7	+25.4
Pediatrics subspecialties‡	35,643	78.9	44,427	82.9	+24.6
Physical medicine–rehabilitation	33,245	87.8	47,792	81.6	+43.8
Psychiatry–child psychiatry	35,576	84.7	43,521	83.9	+22.3
Radiology and subspecialties	30,983	83.4	43,614	80.6	+40.8
General surgery	33,268	80.1	41,681	80.1	+25.3
Surgical subspecialties§	38,766	76.5	46,162	78.8	+19.1
Urology	37,412	74.0	38,288	74.7	+2.3
All respondents	33,499	82.1	42,374	81.3	+26.5

*Internal medicine subspecialties are cardiovascular disease, critical care, endocrinology and metabolism, gastroenterology, hematology, infectious disease, medical oncology, nephrology, pulmonary disease, and rheumatology.

†Obstetrics-gynecology subspecialties are gynecologic oncology, maternal and fetal medicine, and reproductive endocrinology.

‡Pediatrics subspecialties are cardiology, critical care, endocrinology, hematology–oncology, nephrology, and neonatal–perinatal medicine.

§Surgical subspecialties are critical care, pediatric surgery, colon and rectal surgery, plastic surgery, and thoracic surgery.

and anesthesiology had the lowest average debt levels. The highest average debt levels of graduates in both years were for those selecting emergency medicine and surgical subspecialties. Compared with 1986, the average debt of indebted graduates selecting general and subspecialty internal medicine in 1989 was slightly larger than the overall average debt. In 1989, graduates with specialty choices in emergency medicine, physical medicine, surgical subspecialties, obstetrics-gynecology and its subspecialties, and neurology, had the highest average debt levels.

The percentage of indebted students dropped slightly from 82.1% to 81.3%, but the percentage changes differed by specialty. The percentages with debt increased for pediatric subspecialties, neurology, and neurological surgery, while the percentages decreased for physical medicine, otolaryngology, dermatology, and emergency medicine.

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